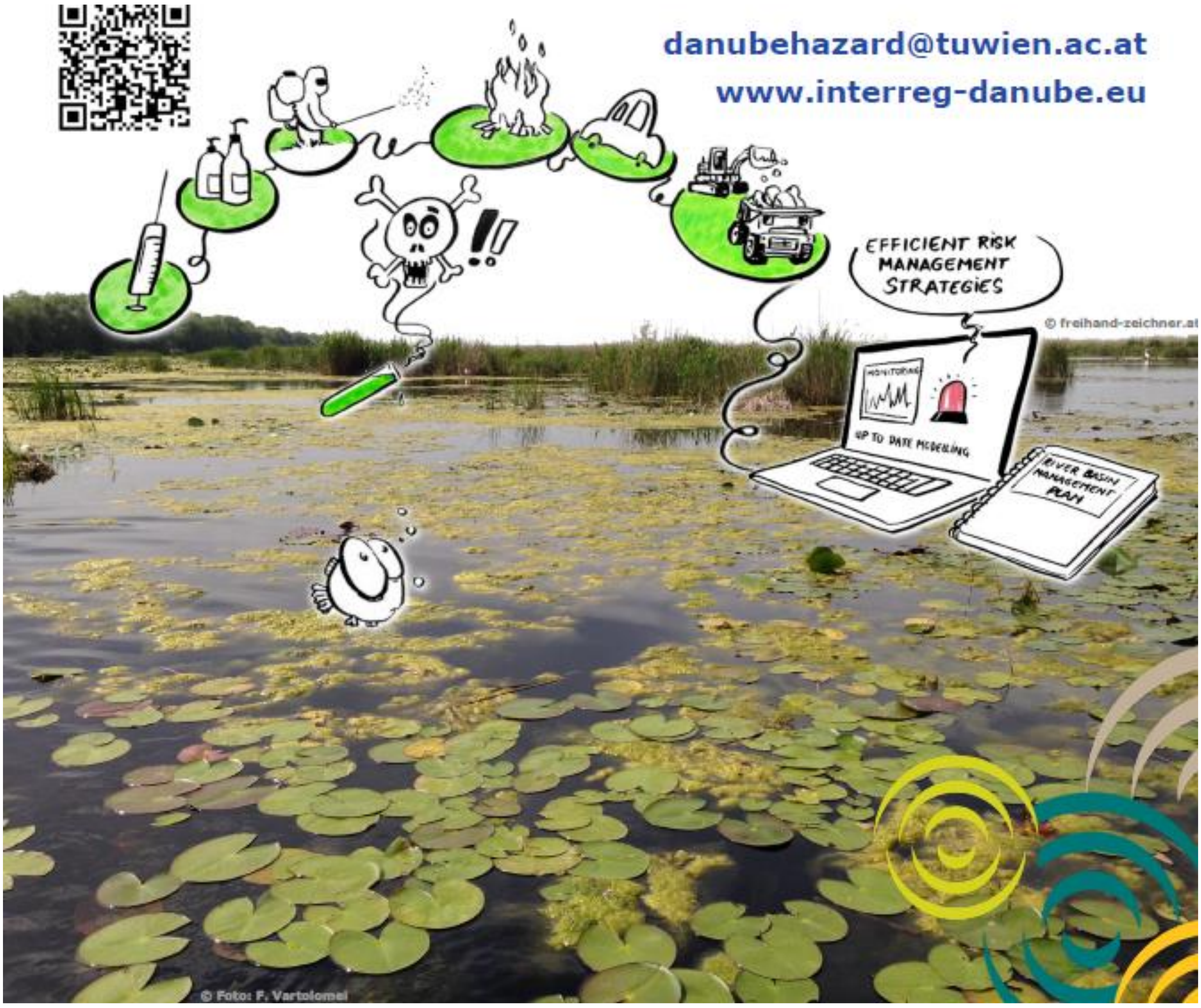

Output T2.3

Demonstration of the management plan development process at watershed levels for Hazardous Substances pollution based on detailed emission modelling in seven pilot regions 2023

Factsheet for the Somesul Mic Pilot area

Project co-funded by European Union funds (ERDF, IPA, ENI) and National Funds of the participating countries

PROJECT TITLE: Tackling hazardous substances pollution in the Danube River Basin by Measuring, Modelling-based Management and Capacity building

ACRONYM: Danube Hazard m^{3}c

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1. General introduction

Based on a one-year surface water monitoring, samples were taken once a week and combined to two-months composite samples and analyzed. Sampling took place mostly at low and mean flow conditions. The monitoring was established in all seven pilot regions in four countries (RO, BG, HU, AT) with a total of 20 surface water monitoring sites. From these results a mean annual concentration was calculated, which should be comparable to 12 fold monthly monitoring results, often used for the risk assessment under the Water Framework Directive. The risk assessment considers the following different inorganic and organic substances:

- Perfluorooctanesulfonic acid (PFOS), Perfluorooctanoic acid (PFOA) (industrial chemicals)
- 16 EPA Polycyclic aromatic hydrocarbons (PAHs, industrial chemicals, and combustion by-products)
- Mercury (Hg), Cadmium (Cd), Copper (Cu), Nickel (Ni), Lead (Pb), Zinc (Zn), Chromium (Cr) and Arsenic (As) (metals)
- Diclofenac and Carbamazepine (pharmaceuticals)
- 4-tert-Octylphenol (industrial chemical)
- Nonylphenol (industrial chemical)
- Bisphenol A (industrial chemical)
- S-Metolachlor (herbicide) including Metolachlor-ESA and Metolachlor-OA (metabolites)
- Tebuconazole (fungicide)

Results from all monitoring stations were compared with the environmental quality standards (EQS) of Directive2008/105/EU (Priority Substances) and with the substances enacted at the national level (National Substance List). Exceedances are shown in **Fehler! Verweisquelle konnte nicht gefunden werden.**.

Table 1 Overview of the exceedance of the EQS in all pilot areas. The numbers indicate the number of sites, regions and countries with exceedance of the EQS values

Substance > EQS	Substance Group	No of monitoring sites	No of pilot regions	No of countries	Regulation
PFOS	Industry	9	5	4	Directive 2008/105/EU
Cu	Heavy Metals	2	1	1	National Substance List
Cd	Heavy Metals	2	1	1	Directive 2008/105/EU
Zn	Heavy Metals	2	1	1	National Substance List
s-Metolachlor	Pesticides	2	1	1	National Substance List

In a second step, for each substance, dominant pathways were evaluated for each catchment by means of emission modelling. Considering the dominant polluters or pathways, scenarios were formulated, which, describe the general potential of a specific measure to mitigate pollution.

The emission modelling was carried out for 34 sub-catchments in seven pilot areas which are situated in four countries. A detailed description of the model, the modelling results and validation can be found in OT 2.2 Report on improved system understanding.

Note: The new proposals of the revised Priority Substance List were also assessed, but do not form a legal basis for the designation of measures at the present time.

2. General information Somesul Mic Catchment

The modelled catchment consists of six analytical units. The outlet of the investigated area (analytical unit 31001) is situated downstream the town of Cluj-Napoca with more than 320.000 inhabitants. Monitoring sites are situated at the outlet (31001), the upstream area (31003) and the tributary Nadas.

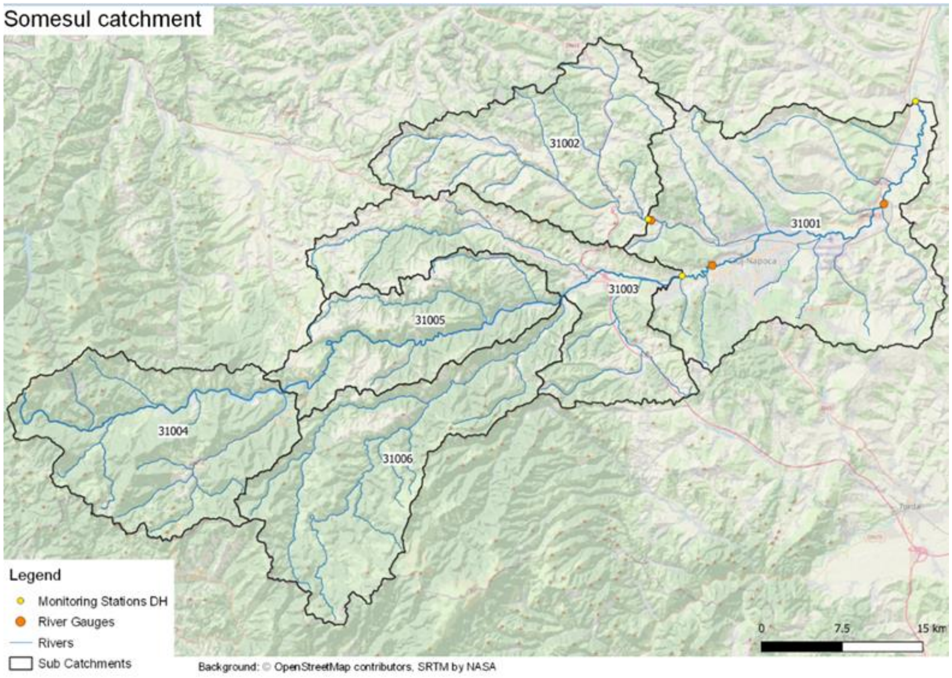

Figure 1 Overview of the pilot area, with monitoring stations

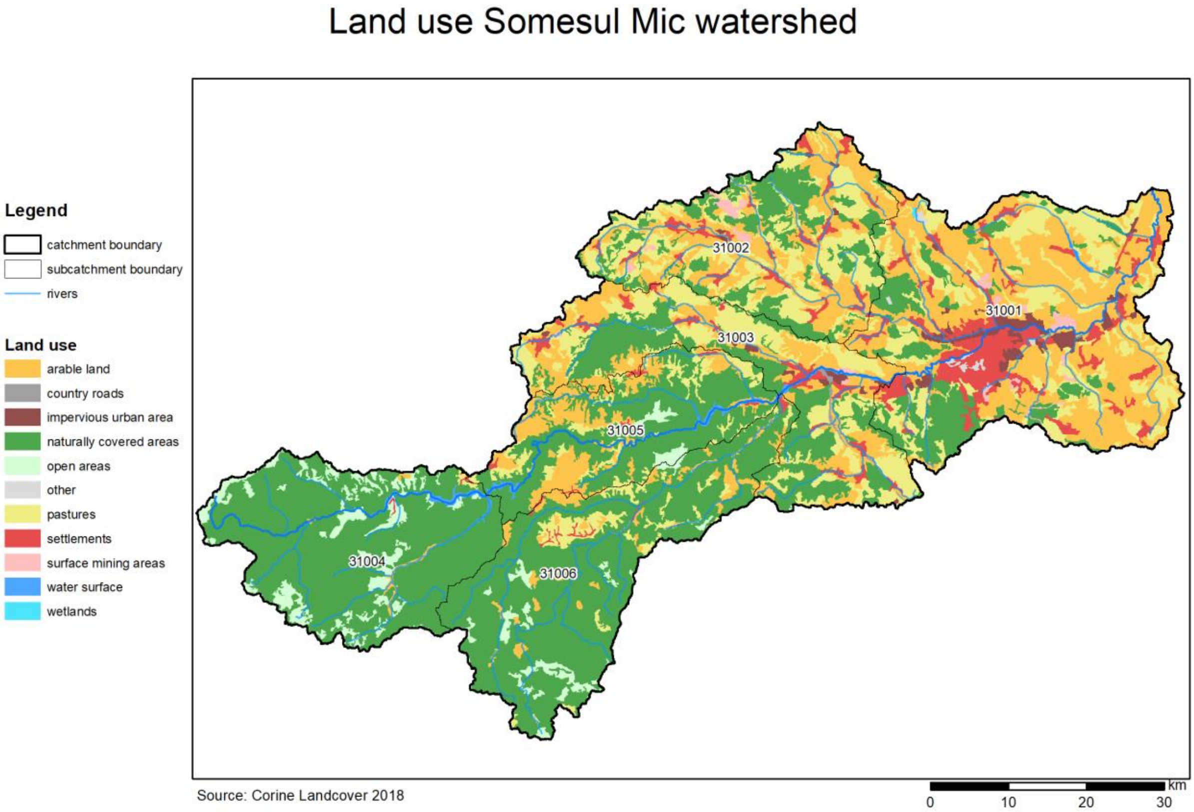

Figure 2 Land use in the pilot area

While the upstream area is clearly dominated by forests and pastures in the downstream regions, agriculture and urban areas become more important. The increased population density of around 200 inhabitants per km^2 is due to the high number of inhabitants in Cluj-Napoca. The same applies to the relatively high proportion of urban area. The pilot region has a moderate runoff.

Table 2 Basic information for the Somesul Mic pilot area

Pilot region	Catchment Area [km2]	Mean Eleva-tion [m]	Population density [Inh/km2]	Arable land [%]	Arable land > 4% slope [%]	Pasture [%]	Forest [%]	Urban Area [%]	Runoff [mm]
Somesul Mic	1959,7	787	197	10,5	6,7	17,2	48,6	5,6	246

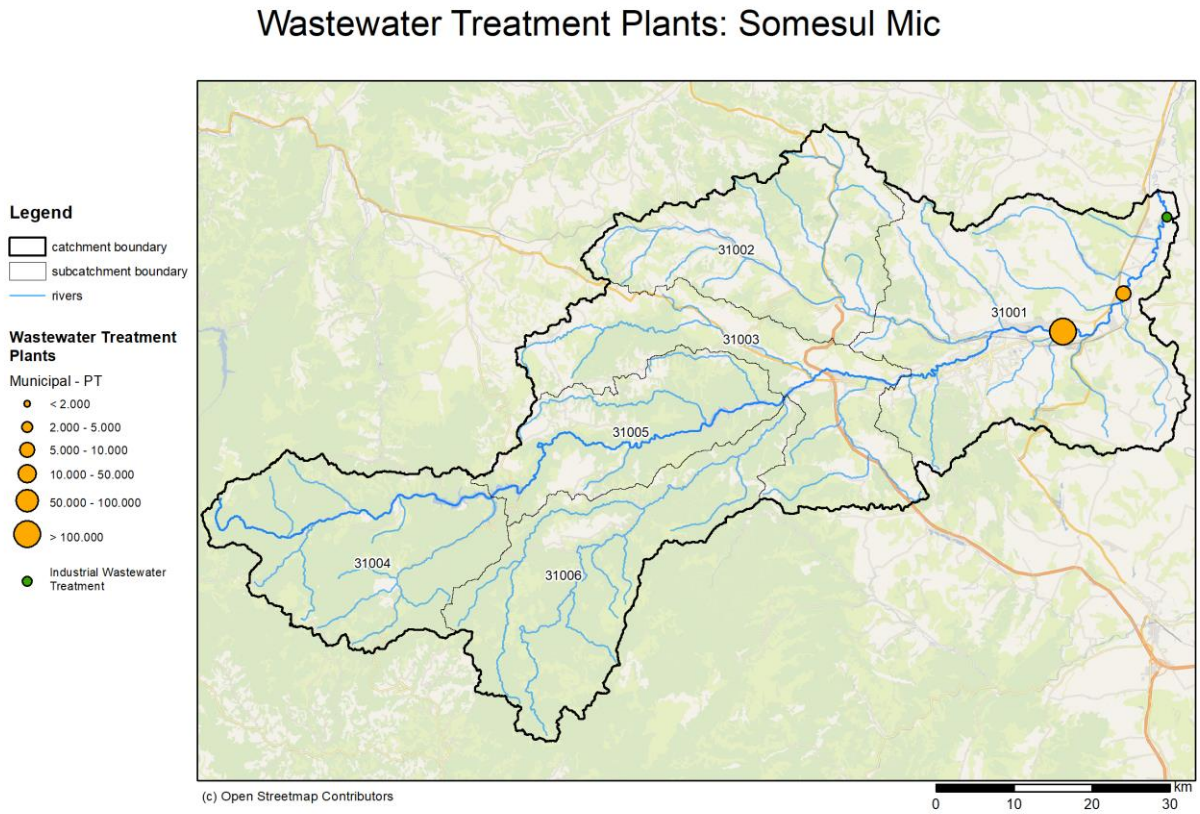

Figure 3 Overview of the point sources in the pilot area

In the Somesul Mic catchment there are two municipal WWTPs and one industrial WWTP in sub ca tchmen 31001 (outlet).

3. Risk assessment: Industry and wastewater/Perfluorooctane sul-fonic acid (PFOS)

Exceedance of the EQS (0,00065 µg/l) at the outlet of the study area (31001) with factor 1,5.

General information: Perfluorooctane sulfonic acid (PFOS) (CAS number 1763-23-1) belongs to the substance group of per- and polyfluorinated alkyl compounds. Due to the surface-active properties of PFOS and related compounds, they are also referred to as perfluorinated surfactants (PFTs). PFOS were formerly used in a wide variety of applications such as fire extinguishing foams, photo resist paints, photographic coatings, medical devices, insecticides, textiles and carpets, and paper and packaging. Due to persistence and surface-active properties, once contaminants such as PFOS enter wastewater, they are very difficult to remove. The main pathways of PFOS to enter in surface waters are wastewater effluents (industrial and municipal wastewater), surface runoff and groundwater.

3.1 Specific situation for Somesul Mic

While in the analytical unit 31001 the dominant share of the PFOS emission stems from the Wastewater Treatment Plants and a further serious share from combined sewer systems and storm-water overflows other pathways are more relevant in the more rural upstream regions and in the sub-catchment of the tributary Nadas. Here surface-runoff and groundwater and interflow are much more important. However, these emission do not result in an exceedance of PFOS EQS in the up-stream catchments! This finding is also supported by the model results in the other sub-catchments, which calculate concentration well below the EQS in all other sub-catchments.

Data of PFOS from municipal WWTP in Romania (as well as many other European countries) are sparse. In the Somesul Mic catchment three waste water Treatment Plants (Cluj Napoca, Apahida and Tetarom III (Jucu)) were monitored in the project (3x influent and effluent weekly composite sample). In order to increase the robustness of the assessment, the project adds data from different Danube countries in a data base that will be used for a possible evaluation of measures.

As a result, the focus can be laid on the inputs from the outlet catchment area and concentrate on improving the purification capacity of the large Waste Water Treatment Plant of Cluj Napoca. The treatment plant has a capacity of 414.000 p.e. and a load of 366.867 p.e. and is equipped with nutri-ent removal stage (N and P).

Information from the Swedish EPA (2017) point out, that the purification capacity of PFOS can be increased to 75 % by using activated carbon. Moreover, the expansion of the large wastewater treat-ment plant of Cluj Napoca with an advanced purification stage is in line with actual proposals from the revised UWWTD for micro-pollutants presented for discussion with the member states. Here, a 4 treatment stage on municipal wastewater treatment plants >100,000 p.e. to be implemented by 2035 is proposed. The model results show a clear increase in the area specific total loads for PFOS in 31001 (outlet) where all WWTPs are situated (see Figure 4). This is also reflected in the relative share of the different pathways in all sub cachtments. In the upstream catchments, there is a large share of diffuse pathways, whereas in the outlet the vast share of the PFOS emmisions comes from the minu-cipal WWTPs.

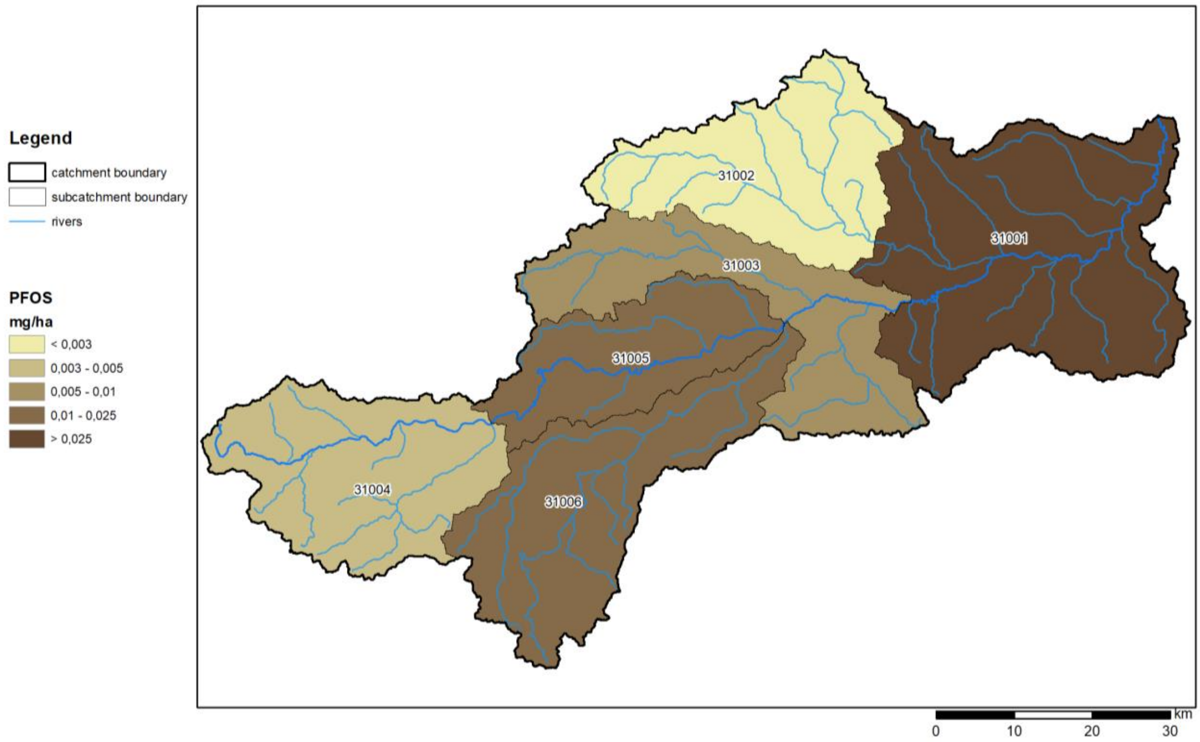

Figure 4 Overview of the point sources in the pilot area

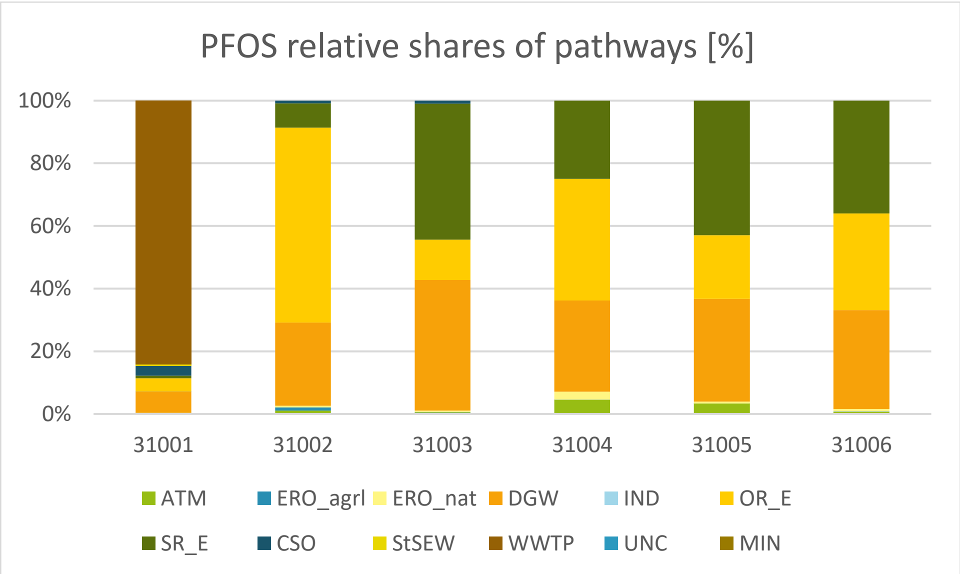

Figure 5 relative share of pathways in the Somesul Mic Catchment for PFOS (ATM: atmospheric deposition; ERO_agrl: erosion from agricultural land; ERO_nat: erosion from forests; DGW: groundwater baseflow+interflow+drainages; IND: industrial point sources; OR_E: extra-urban roads; SR_E: surface runoff; CSO: combined stormwater overflow; StSEW: strom sewer; WWTP: municipal WWTP; UNC: sewer systems not connected to WWTP; MIN: abandoned mining)

3.2 Proposals for potential mitigation measures:

Advanced wastewater treatment for municipal wastewater treatment plants with a capacity of > 100.000 p.e.. Adsorption stage (activated carbon) at the large treatment plant of Cluj Napoca. Beneath a serious further reduction of PFOS, this would have a large additional positive effect on a huge number of organic and inorganic pollutants and the water quality of Somesul Mic downstream Cluj Napoca.

Please note: The proposed measures are based exclusively on what is theoretically feasible and quantifiable as a scenario in the model. They do not consider the aspect of proportionality and have no impact on a possible practical implementation!

3.3 Results from the modeled scenarios

In the emission model only the measure Advanced wastewater treatment at the municipal wastewater treatment plants (> 100.000 p.e.) was implemented.

If the PFOS concentration of municipal WWTPs with a capacity above 100.000 is reduced by 75%, due to the implementation of advanced treatment with activated carbon, the river concentration of PFOS is reduced by 50% in 31001 (outlet). In the other catchments, there is no reduction of the PFOS river concentration, because there are no municipal WWTPs in the other sub catchments.

3.4 Initiate a stakeholder involvement

In the scope of this project a questionnaire was set up to gain information on the feasibility of mitigation measures concerning the reduction of PFOS concentrations in the Somesul Mic catchment. The questionnaire was answered by 12 local, regional and national experts. Of these 12 experts 11 believe that advance treatment for the Cluj Napoca WWTP is feasible from a technical point of view. 12 experts believe advance treatment for the Cluj Napoca WWTP is feasible from a financial point of view. The realistic timeline for the extension with advanced treatment seems to 10 years (9 out of 12 anwers). However 12 out of 12 experts think that advance treatment in the WWTP of Cluj Napoca will not result in meeting the EQS for PFOS. 6 experts think that a further reduction of PFOS can be achieved by other measures as: reduction or other measures at the source, nature based solutions and building additional WWTPS.

4. Closing the data gaps

For this project for Romania, erosion data from JRC were used. For Romania the erosion rates in both catchments where reasonable, however it is advised that a countrywide erosion model should be developed.

5. Literature:

Swedish EPA (2017). Advanced wastewater treatment for separation and removal of pharmaceutical residues and other hazardous substances: Needs, technologies and impacts. Swedish Environmental

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